

BEST AVAILABLE COPY

This is the SAFT/VALEO Presentation

That was presented at the

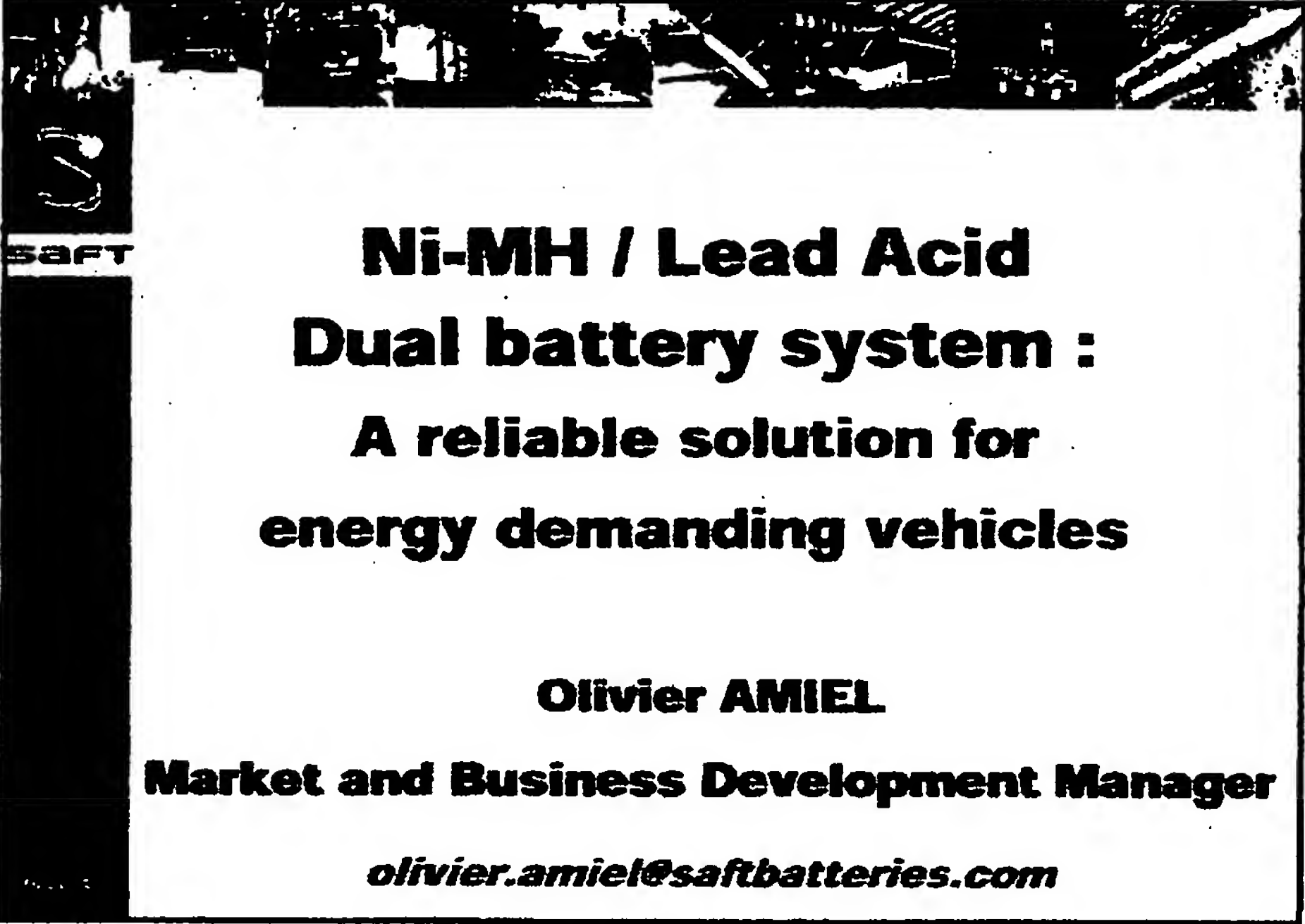
“Advanced Automotive Battery Conference”

In San Francisco California on

June 13th 2004

BEST AVAILABLE COPY

*** Dr. Menahem Anderman Founded this Conference.**



**Ni-MH / Lead Acid
Dual battery system :
A reliable solution for
energy demanding vehicles**

Olivier AMIEL
Market and Business Development Manager
olivier.amiel@saftbatteries.com

■ CONTENT

- INTRODUCTION
- TECHNICAL DESCRIPTION
- FINANCIAL APPROACH
- CONCLUSIONS

■ INTRODUCTION

- • Background
- • Vehicle evolution
- • Dual battery system concept

3

ANECOS - SAFET - 1994 - 1995

© AMEL

SAFT

■ Background : lead acid is reaching its limits...

Most frequent failures in a vehicle are
electrical ones



■ Among the electrical failures,
50% are related to the lead acid battery



Consequence :
Vehicle stopped !



4

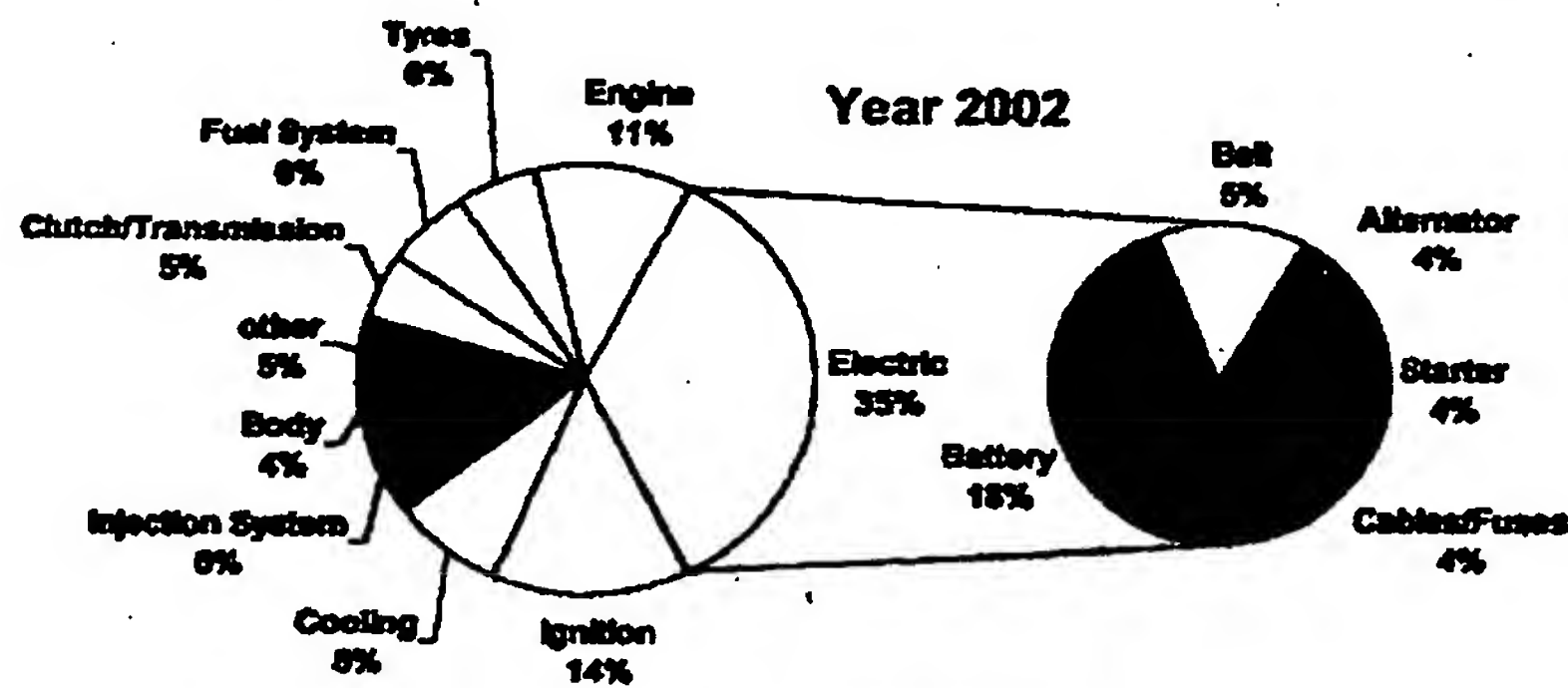
SAFT - 1994 - 1995

© AMEL

SAFT

■ FAILURE PARETO

Electrical failures, and more specifically battery failures are the N°1 cause of vehicle failure



Breakdowns statistics compilation from majors automobile associations (ADAC, AA, GfPA, TCS,...)

■ Vehicle evolution : energy consumption still increasing...

• Booming of "life on board" features

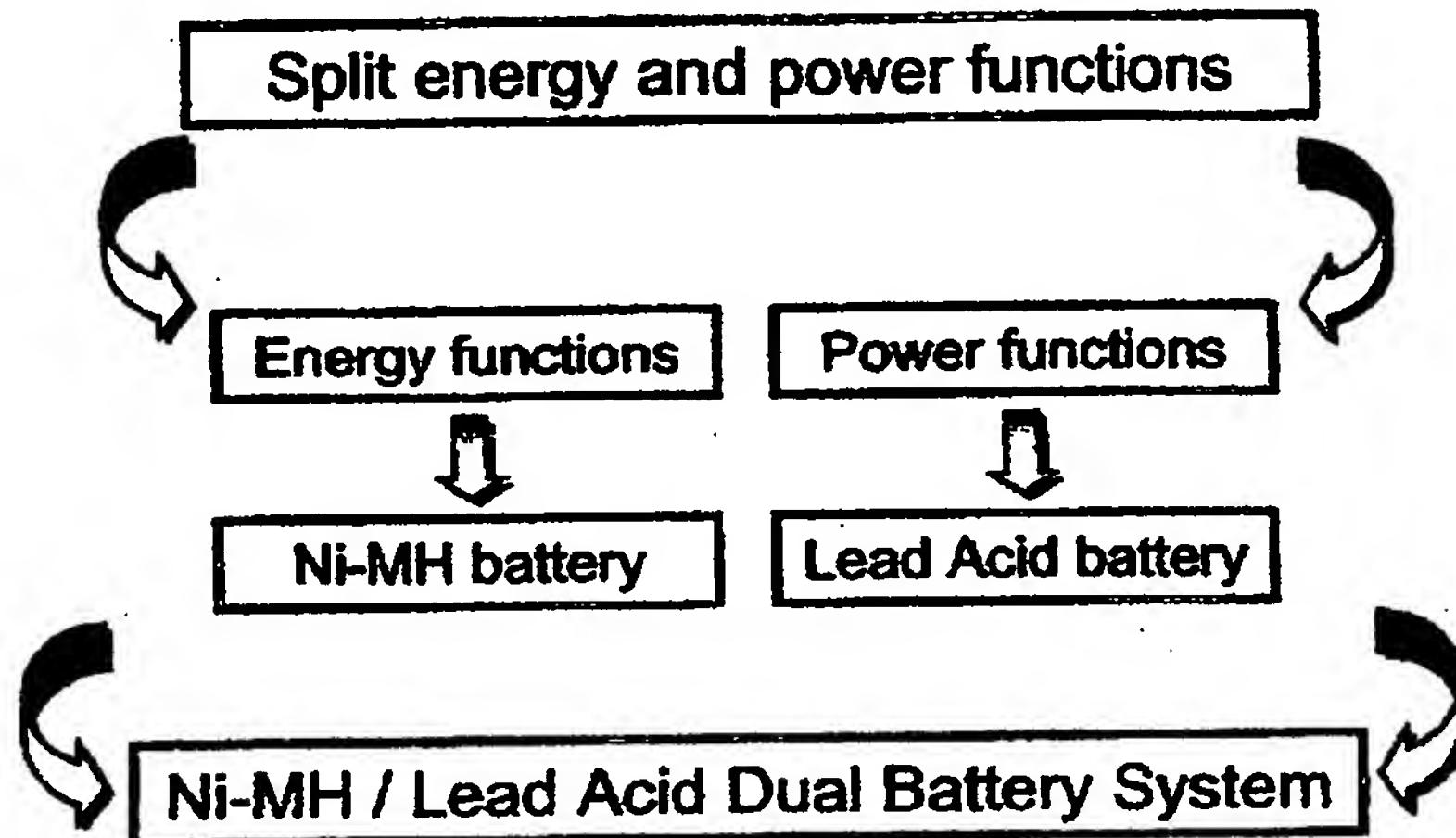
- Energy need increases permanently
- Development of energy demanding features
 - Entertainment : DVD player, GPS...
 - 12V network : Games, tools, heater, mini-fridge...
- Increasing use of these features during idle stop
- Introduction of vehicle pre-conditioning features
 - pre-heating or pre-cooling functions
 - highly energy demanding functions

Lead acid batteries are
more and more deep cycled

• Introduction of Stop & Go vehicles

- Idle stop phases more frequent
- Increase of energy consumption

■ Dual battery system concept



SAFT 114 - San Francisco - July 1994

SAFT

SAFT

■ TECHNICAL DESCRIPTION

• MODEL DATA

- Number and type of stops
- Battery module options
- Duty cycle profile
- Temperature profile

• PROPOSED SOLUTIONS

- Ni-MH cell technology
- Battery module performance
- Battery module architecture
- Electronics architecture

SAFT 114 - San Francisco - July 1994

SAFT

SAFT

■ MODEL DATA :

Number and type of Stops

• Assumptions

- Annual mileage : 12,500 mile / year
 - Average speed : 25 mile / hour
 - Average distance : 35 mile / day
- } ~500 h / year

• Types of Stop

- Stop / Go : 80 stops / day (7/7)
- Utility stop : 20 stops / day (5/7)
- Pre-conditioning : 2 cycles / day (5/7, 3 months / year)

• Number of Stops

Stop type	Stop/Go	Utility	Pre-conditioning
Duration (sec)			
Number / day			
Number / week			
% usage / year			

9 AAB019 2nd Edition 10/01/01 10/01/01

SAFT

SAFT

■ MODEL DATA :

Battery module options

• Selected onboard features

- Data derived from the European SCIWork work team

• Three 10.8V battery module options

- 400 W / 9 Ah
- 800 W / 12 Ah
- 1000 W / 15 Ah

• Example : 400W battery module

Power and Energy needs			
Features	Power (W)	Energy (Wh) need per stop	Capacity (Ah) need under 10.8 V
Electronics	120,0	10,8	1,0
Heaters	10,0	0,8	0,1
Lamps	160,0	14,5	1,3
Motors	80,0	6,9	0,6
Others	20,0	3,3	0,3
Solenoids	0,0	0,0	0,0
TOTAL	400,0	36,3	3,3

10 AAB019 2nd Edition 10/01/01 10/01/01

SAFT

SAFT

Duty cycle profile (1/2)

- **General assumptions**

- Energy consumption in stop phase only
- 3 types of vehicle considered
 - Utility vehicle
 - Small vehicle with S&G
 - Large vehicle with / without pre-conditioning

- **Pre-conditioning**

- Pre-conditioning 3 months / year (1,5 month in summer & winter)
- Summer : 2 times per day (12 AM and 2 PM) @ 50% power
- Winter : 2 times per day (8 AM and 6 PM) @ 100% power

- **Stop and Go**

- Trip duration with S&G :
21,5 min = 11,5 min driving + 10 min S&G

AA5004 5/21/2001 0 - 1 145024

2000

SAFT

Duty cycle profile (2/2)

- **Duty cycle per vehicle type**

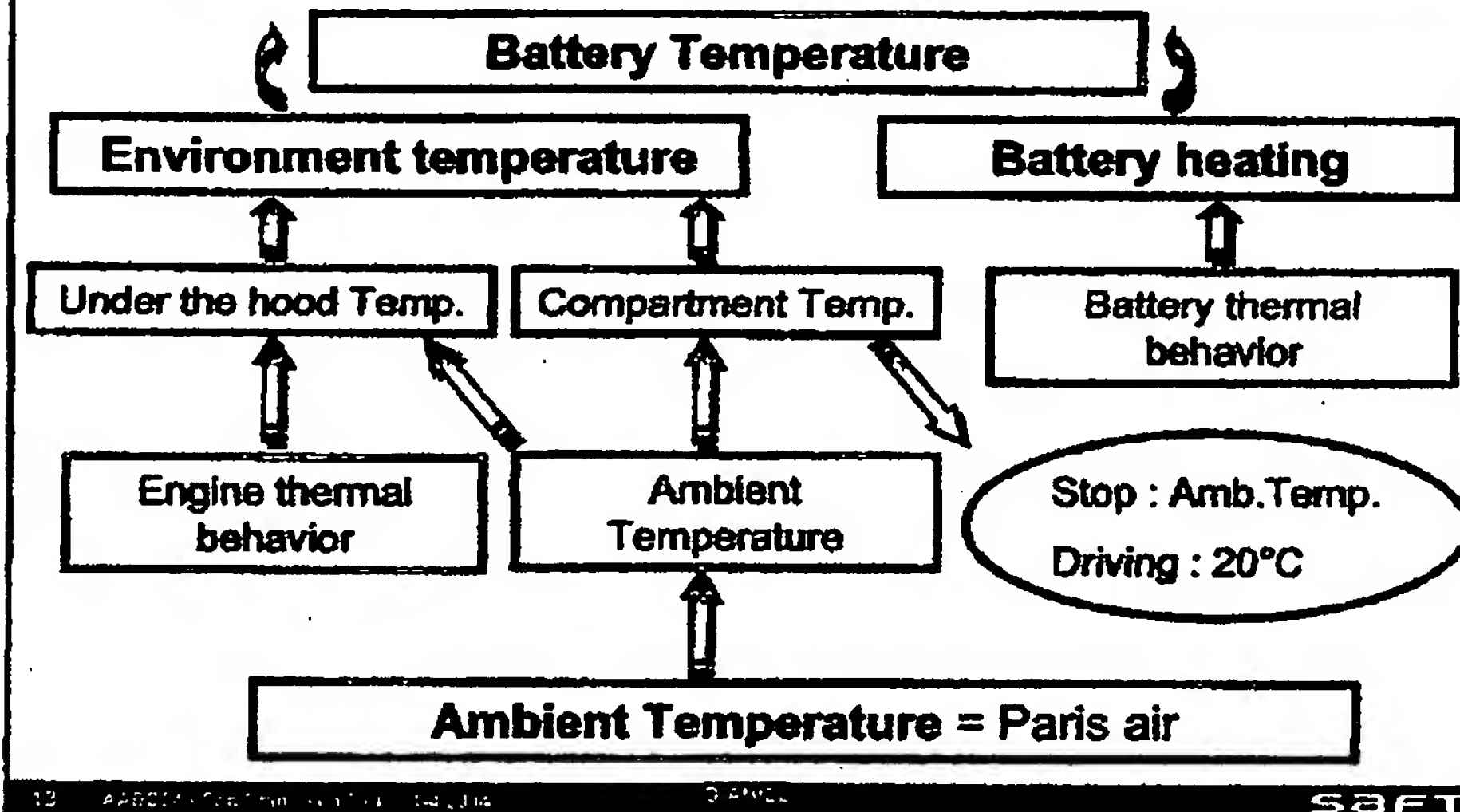
400W module		800W module		1000W module	
Without S&G	With S&G	Without pre-conditioning	With pre-conditioning	Without pre-conditioning	With pre-conditioning
Utility Vehicle	Small vehicle	Large vehicle	Large vehicle	Grand VP	Grand VP
25 min driving 5 min stop	21.5 min driving 20 stops S&G	Standard profile 2 h @ 70W / day, 1 day / week 10 months / year	Standard profile 2 h @ 70W / day, 1 day / week 10 months / year	10 min pre-conditioning 21.5 min driving	10 min pre-conditioning 21.5 min driving
8 times in the morning	3h rest			3h rest	3h rest
	21.5 min driving 20 stops S&G			21.5 min driving 1h rest 21.5 min driving	21.5 min driving 1h rest 21.5 min driving
1h rest	1h rest			4h rest	4h rest
25 min driving 5 min rest	21.5 min driving 20 stops S&G	Specific profile (vacation) 2 h @ 70W / day, 3 days / week 2 months / year	Specific profile (vacation) 2 h @ 70W / day, 3 days / week 2 months / year		
12 times in the afternoon	4h rest				
	21.5 min driving 20 stops S&G				

17 AUGUST 2004

2000

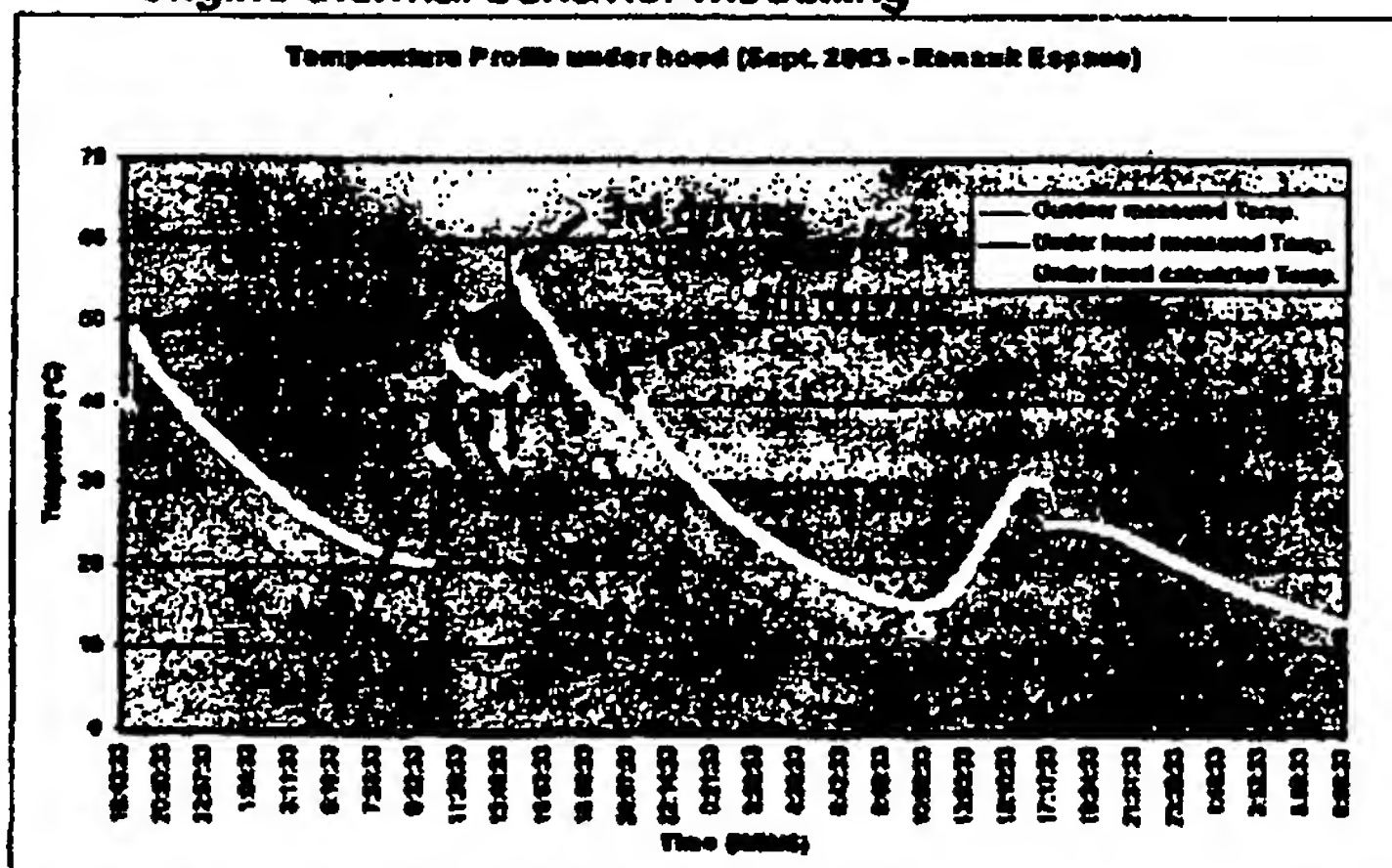
SAFT

■ MODEL DATA : Temperature profile (1/3)



■ MODEL DATA : Temperature profile (2/3)

- Under the hood temperature
 - engine thermal behavior modelling



■ MODEL DATA :

Temperature profile (3/3)

- Battery temperature

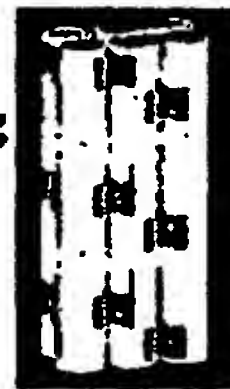
Battery thermal behavior modelling :

$$T_{battery} = f(T_{battery-1}, T_{environment}, Battery\ Coefficient)$$

Battery Configuration	9S1P	9S2P
Battery Coefficient		
Battery w/o casing	1	1
Battery with casing	0,7	0,4
Battery with casing / cooler	1,2	1,2

Example :

9S2P w/o casing



Battery configuration and location determine the battery temperature

Life duration

16 SAFT

SAFT

■ PROPOSED SOLUTIONS :

Ni-MH cell technology

A customized Ni-MH technology

- Saft VHT product range :

- Initially designed for ELU applications
 - Saft → WW leader (70% market share)
- With unique features :
 - Energy applications
 - High temperature environment (40~50°C)
 - Long life duration (>8 years @ 40°C)
- Product range :
 - VHT AA 1 Ah / available
 - VHT Cs 2 Ah / available
 - VHT F 10 Ah / Q1'05 commercial launch



17 SAFT

SAFT

PROPOSED SOLUTIONS : Battery module performance

	400W module		800W module		1000W module	
	Without SAG	With SAG	Without SAG	With SAG	Without SAG	With SAG
Utility vehicle	Small vehicle	Small vehicle	Large vehicle	Large vehicle	Large vehicle + Pre-conv.	Large vehicle + Pre-conv.
Battery configuration	9S1P	9S1P	9S2P	9S2P	9S3P	9S3P
Cell type	1 layer 3x3	1 layer 3x3	2 layers 3x3	2 layers 3x3	3 layers 3x3	3 layers 3x3
Ni-MH cell type	VHT F	VHT F	VHT F	VHT F	VHT F	VHT F
Battery capacity	9 Ah	9 Ah	18 Ah	18 Ah	27 Ah	27 Ah
capacity need	3 Ah	0.3 Ah	12 Ah	12 Ah	15 Ah	15 Ah
800	35%	3%	65%	65%	65%	65%

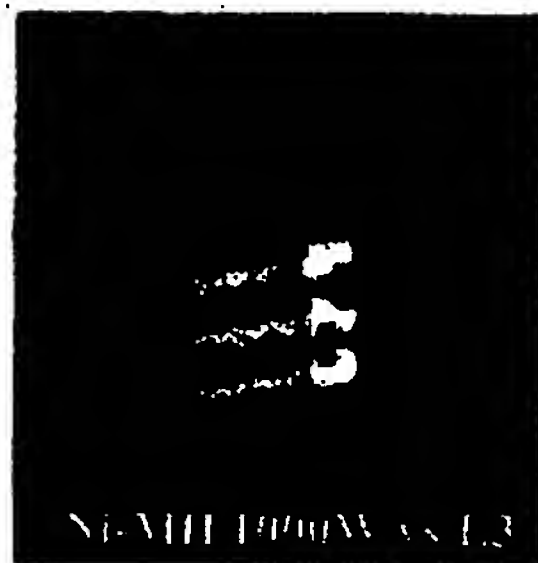
Battery (with cooling) location	compartment	compartment	compartment	under the hood	compartment	under the hood
Battery cooling						
driving + stop (SAG) phase	yes	yes	no	no	no	no
stop phase	yes	no	no	no	no	no
Temperature increase	+14°C (1 driving)	+30°C (20 stops)	+5°C (per use)	+6°C (per use)	+20°C (per use)	+20°C (per use)

Battery environment	Calculated battery life duration					
Peris air during driving and rest	6 years	5 years	10 years	7 years	9 years	7 years
Peris air during rest	5 years	4 years	8 years	7 years	7 years	7 years
Under the hood air				7 years		6 years

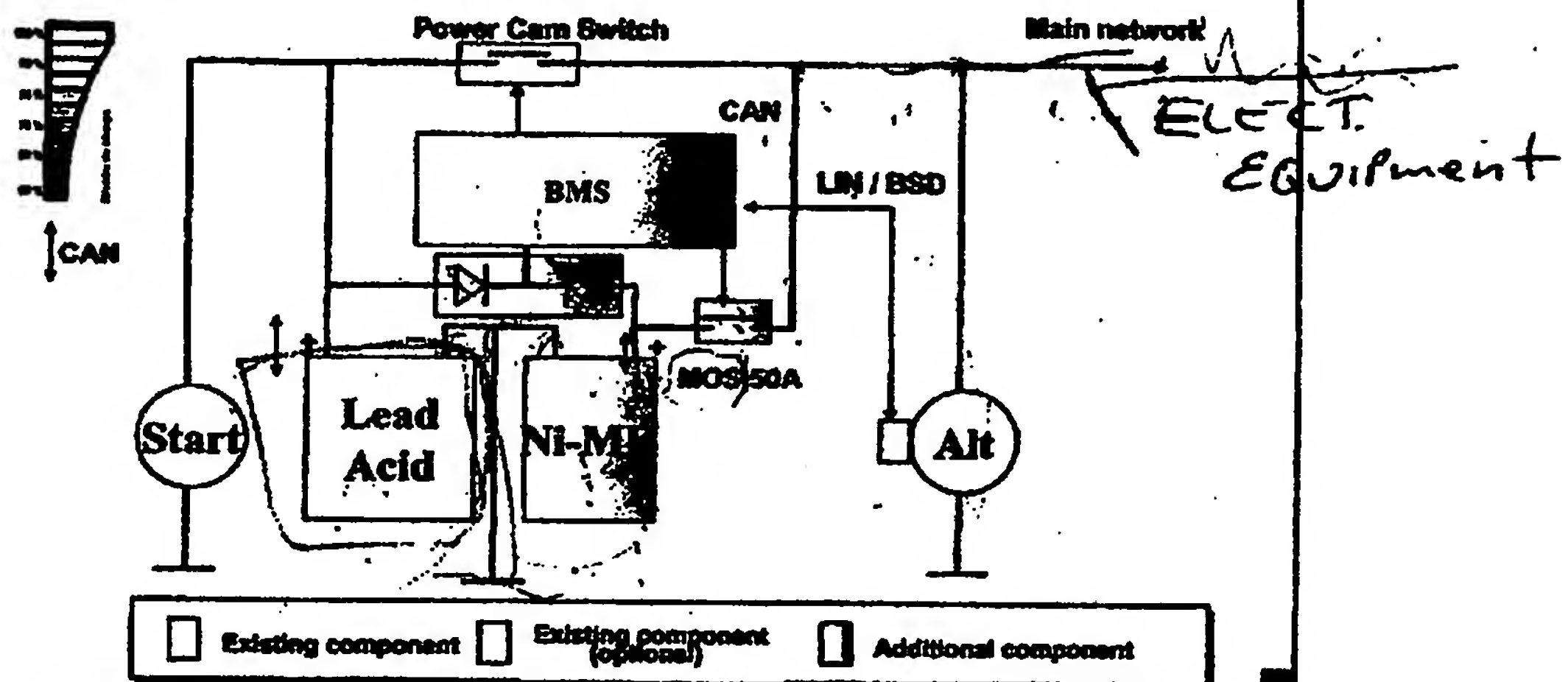
PROPOSED SOLUTIONS : Battery module architecture

Ni-MH versus Lead-Acid

Battery module	Lead-acid (12V - 55 Ah)	Ni-MH 400W (10,8V - 9 Ah)	Ni-MH 800W (10,8V - 18 Ah)	Ni-MH 1000W (10,8V - 27 Ah)
Dimensions	L3			
L : W : H (mm)	278 : 175 : 190	270 : 37 : 105	270 : 68 : 105	270 : 105 : 105
Volume (l)	9,2	1,0	2,0	3,0
Weight (kg)	18,0	2,5	5,0	7,5



PROPOSED SOLUTIONS : Electronics architecture



19 AAD014 - 31/01/2014 - 14/01/2014

10/01/14

SAFT

No 60

FINANCIAL APPROACH

- Ball park pricing for 400 W, 800 W and 1000 W modules

PROJECTED PRICING

Battery module type	400 W module		800 W module		1000 W module	
Annual quantities	10 K	100 K	10 K	100 K	10 K	100 K

Battery price :						
€	85	75	160	140	240	210
€/kWh	874	772	823	720	823	720
Electronics price :						
€	40	25	40	25	40	25
Total System price :						
€	125	100	200	165	280	235

10 AAD014 - 31/01/2014 - 14/01/2014

10/01/14

SAFT

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.